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Joint Service Multipurpose Arcade Combat Simulator (JMACS) User Guide

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Fort Benning Field Unit
Training Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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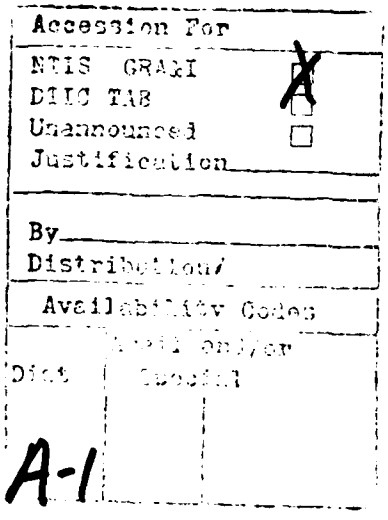

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The Multipurpose Arcade Combat Simulator (MACS) is a part-task weapons trainer that consists of a microcomputer, video monitor, program cartridge, and long-range light pen mounted to a demilitarized weapon. Although designed to provide inexpensive training with a variety of weapon systems, interest has focused largely on its use as a rifle marksmanship trainer. Because of U.S. Army, Navy, and Air Force interest in the potential applications of MACS technology in their respective weapons training programs, a 2-year Joint Service MACS (JMACS) program was initiated in 1986. The JMACS User Guide was developed to support instructor training before user testing in each Service. It presents information on system assembly, operation, and troubleshooting. Features of JMACS training software and associated performance standards also are described.

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Joint Service Multipurpose Arcade Combat Simulator (JMACS) User Guide

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Education and Training

FOREWORD

The Multipurpose Arcade Combat Simulator (MACS) is an inexpensive part-task weapons trainer that was developed to overcome training problems encountered because of insufficient facilities and instructors. Because it uses mostly off-the-shelf components, MACS is substantially lower in cost than commercially available training devices, although essentially it is equally effective. While current interest is focused largely on its use as a rifle marksmanship trainer, MACS was designed to provide training on a variety of weapon systems.

Exploratory research on the MACS concept began in late 1982. Since that time, over 20 developmental hardware tests, training and cost effectiveness evaluations, and informal field investigations have been conducted. The benefits associated with MACS training appear to be increased performance, fewer failures to meet performance standards, significantly lower ammunition expenditures, improved performance feedback, and greater soldier interest.

Patented in 1986, MACS is a product of the Army Research Institute's Fort Benning Field Unit, which conducts research on training and training technology with particular emphasis on individual and small team skills in the Infantry arena. The research task that supports this mission, "Developing Training for Individual and Crew-Served Weapons," is organized under the "Train the Force" program area. The MACS research program was sponsored by the U.S. Army Infantry School under a Memorandum of Understanding (9 December 1987) and the Army Training Support Center under a Training Device Need Statement for MACS approved in 1984. The Infantry School, as proponent for rifle marksmanship training and training devices, recommended to the U.S. Army Training and Doctrine Command (TRADOC) in December 1987 that MACS systems be acquired for further evaluation at all Army Training Centers.

Because of U.S. Army, Navy, and Air Force interest in the potential applications of MACS technology in their respective weapons training programs, a 2-year Joint Service MACS (JMACS) program was initiated in 1986. The Navy and Air Force evaluated the applicability of MACS in their training programs as part of the JMACS project, sponsored by the Joint Services Program (PE64722A) on Manpower and Training Technology Development. This research product was developed in support of those evaluations.

EDGAR M. JOHNSON
Technical Director

JOINT SERVICE MULTIPURPOSE ARCADE COMBAT SIMULATOR (JMACS) USER GUIDE

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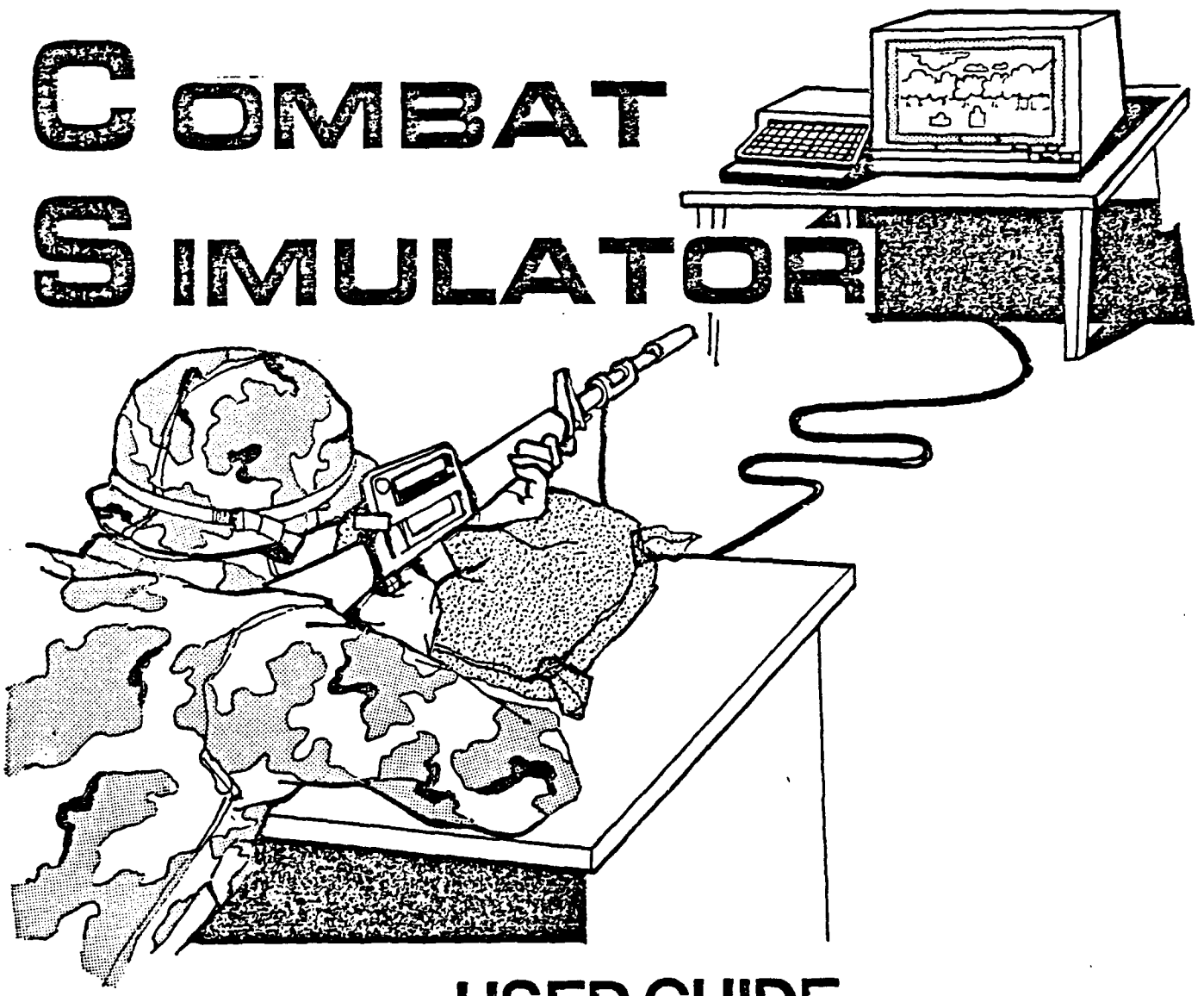
JOINT SERVICE MULTIPURPOSE ARCADE COMBAT SIMULATOR



USER GUIDE

INTRODUCTION

The purpose of this guide is to enable the user of the Joint Service Multipurpose Arcade Combat Simulator (JMACS) to set up, use, and troubleshoot the system. JMACS is a relatively low-cost, part-task trainer that can be used to support training with a variety of weapon systems, including the M72A2 LAW, MK19 Grenade Machine Gun, and the M203 Grenade Launcher. This guide focuses on the use of the system as an M16A1 rifle marksmanship trainer. JMACS can enhance marksmanship training by providing simulated sight pictures, targets with background, wind effects, and most important, precise feedback about hit and miss location.

The JMACS system is composed of a Commodore 64 microcomputer, an optional disk drive, a monitor, a plug-in cartridge containing ten basic rifle marksmanship programs, an M16A1 demilitarized rifle, two joy sticks, and a specially designed long-distance light pen with mount.

Current software programs include:

* Level of Fire I: Introduction to Supported Position
* Level of Fire II: Introduction to Unsupported Position
* Level of Fire III: Timed Targets in Supported Position
* Level of Fire IV: Timed Targets in Unsupported Position
* Level of Fire V: Practice Record Fire I
* Level of Fire VI: Practice Record Fire II
* Level of Fire VII: Record Fire
* Level of Fire VIII: Rapid Record Fire I
* Level of Fire IX: Rapid Record Fire II
* Level of Fire X: Combat Fire

SETTING UP THE JMACS SYSTEM

Setting up the JMACS system is quick and easy if the instructions are followed step-by-step.

READ THE INSTRUCTIONS BEFORE ATTEMPTING SETUP! MAKE SURE THE COMPUTER IS NOT TURNED ON DURING THE SETUP PROCESS OR DAMAGE MAY OCCUR TO THE COMPUTER EQUIPMENT!! See Figure 1 for power switch location.

A. Connecting the Computer Equipment

1. The following equipment should be in each equipment box:

Computer	Monitor
* Computer/Keyboard	* Color Monitor
* Monitor/TV Switch Box	* Three Pronged Color Coded Cable
* Monitor/TV Cable	* Monitor Manual
* Power Supply	
* Computer Manual	

Disk Drive (Optional)	Other Equipment
*Disk Drive Unit	* BRM Cartridge
*Power Supply Cord	* M16A1 Rifle with Light Pen
*Disk Drive/Computer Cable	
*Disk Drive Manual	

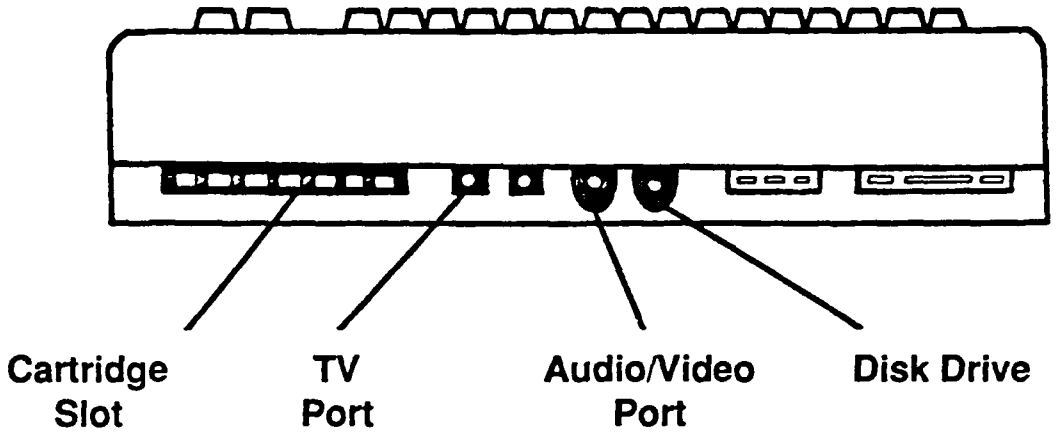
2. Using firm steady pressure, carefully insert the Basic Rifle Marksmanship (BRM) cartridge (label up) into the cartridge slot (see Figure 1). Gently rocking the cartridge left and right will ensure it is firmly seated in the back of the computer keyboard. THE COMPUTER MUST BE OFF BEFORE INSERTING THE BRM CARTRIDGE OR DAMAGE TO THE COMPUTER MAY RESULT!!

3. Plug the power supply cable (see Figure 2) into a three-prong wall outlet (120V AC) and the other end into the port marked "power" on the right side of the computer (see Figure 1).

4. When using the Commodore 13-inch color monitor, insert the three color-coded cable jacks into the corresponding three colored-coded sockets in the right rear of the monitor as shown in Figure 2 (white to white, yellow to yellow, red to red). Insert the plug end of the monitor cable into the audio/video port on the back of the computer (see Figure 1). The monitor cable will only fit the audio/video port. Do not try to force the cable in as it may damage the cable ends. Plug the monitor power cord into a three-prong wall outlet.

5. An ordinary television may be substituted if a Commodore monitor is not available by connecting the TV switch box to the rear of the television. First, disconnect the VHF antenna wires from the VHF terminal on the back of the television. Next, insert these wires under the screws on the bottom of the TV switch box. Connect the short wire on the TV switch box to the VHF terminal on the television. Slide the selector switch to the computer position. Finally, plug one end of the TV cable into the TV port on the back of the

BACK



SIDE

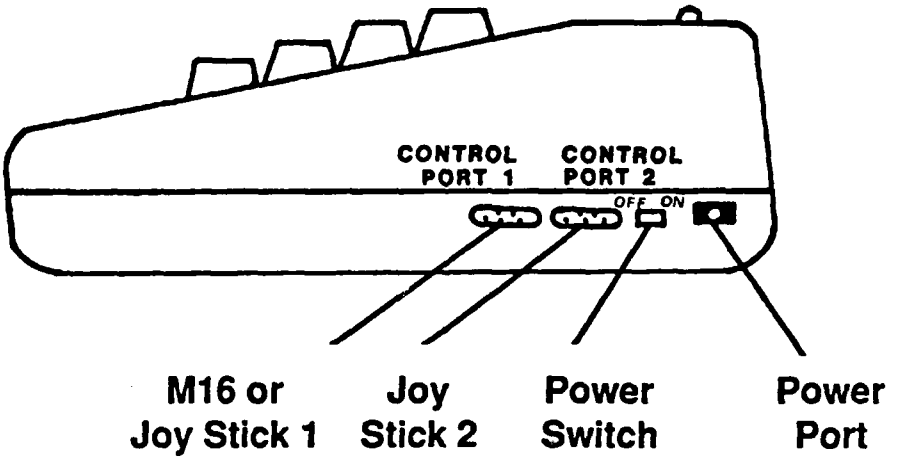


Figure 1. Back and right side view of Commodore 64

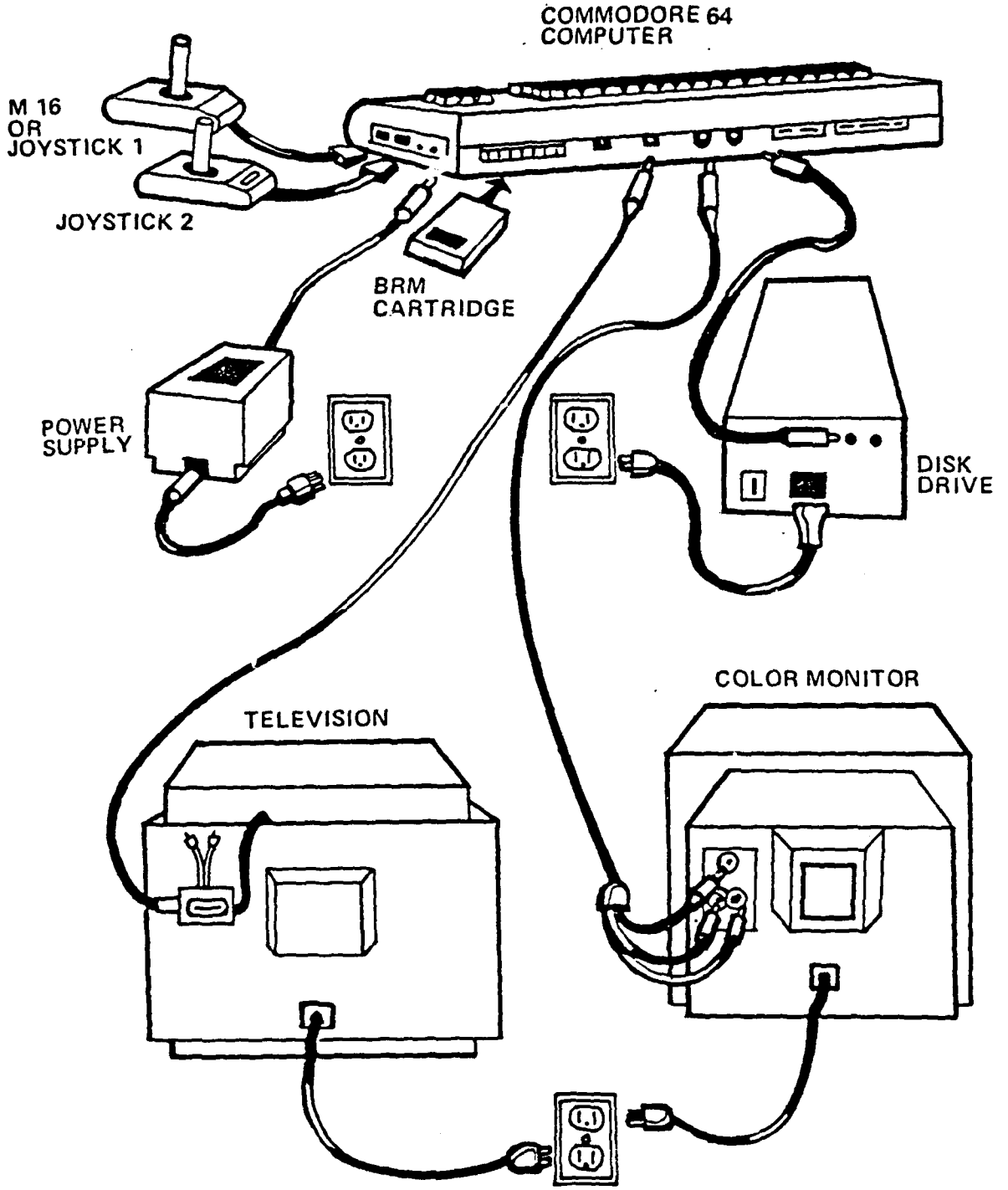


Figure 2. Setup locations of JMACS equipment

computer (see Figure 1) and plug the other end into the port marked COMPUTER at the top of the switch box.

6. Take one end of the disk drive/computer cable and connect into the port on the back of the disk drive and the other end into the port on the back of the computer (see Figure 2). Plug the power supply cable into the power supply port on the back of the disk drive and the other end in a three-prong wall outlet.

7. When using the M16 firing exercise programs, insert the cable plug from the demilitarized M16 into Control Port 1 on the right side of the computer keyboard (see Figure 1). When using the joystick insert the joystick controller cables into Control Ports 1 and 2.

8. Place the monitor on a desk or table 10 feet from the firer's eye. JMACS targets are scaled for this distance and the light pen has been focused to provide optimal performance at this distance.

B. Turning the System On and Off

1. Turn the computer on by pressing the on-off switch located on the right side of the keyboard (see Figure 1).

2. Turn the disk drive on by pressing the on-off switch located on the right rear of the disk drive unit.

3. Turn the monitor on by pressing the on-off button on the right front of the monitor.

4. Once the computer, disk drive and monitor are turned on, an introductory welcome screen should appear (shows target and shooting M16). This is the beginning of the JMACS basic rifle marksmanship programs. If this introduction does not appear, turn the computer off, reinsert the cartridge, and again turn on the computer.

5. When finished using the system simply turn off the computer and monitor. DO NOT REMOVE THE BRM CARTRIDGE BEFORE TURNING OFF THE COMPUTER!

6. If the JMACS system will be used continuously over a number of days, leave the cartridge in the computer after turning the system off. Leaving the cartridge in the computer when JMACS is not being used will not hurt the system but repeated insertion and removal of the cartridge may cause needless wear.

USING THE JMACS SYSTEM

A. Skill Test.

1. Prior to entering the training modes the firer is given a skill test comprised of three shots at a 250 meter E-type silhouette from the supported firing position and three shots from the unsupported firing position. These six shots help determine the initial starting level. The summaries for each three round shot group are displayed on a 250 meter E-type silhouette and the diagnostic ratings for steady position, trigger squeeze, follow through, and shot location are displayed.

2. The first three shots of the skill test are used to automatically establish a zero on the M16 rifle. Manual sight adjustments are not required. DO NOT ATTEMPT TO UNFASTEN OR ADJUST THE LIGHT PEN ASSEMBLY.

B. Training Modes.

1. The trainer has as an option four modes of operation. These modes are the Automatic Mode, selecting a starting point for one firer (Manual Mode 1), selecting one level for all firers (Manual Mode 2), and selecting a starting and stopping level for all firers (Manual Mode 3).

a. Automatic Mode: Pressing the "SPACE BAR" on the keyboard when the JMACS introductory welcome screen is present will start the Automatic Mode. The Automatic Mode will normally begin at Level 1 and run continuously through Level 10.

b. Manual Mode: Pressing the "M" (manual) key at the JMACS introductory welcome screen brings up the Manual Mode. In the Manual Mode, the Levels Menu is displayed (see Figure 3) and the trainer is prompted to select a specific start and stop level.

1) Manual Mode 1: the trainer has the option to select a starting point for one firer. After completing the skill test, the firer begins the program at a specific level based on the results of the skill test. If the trainer wishes a different level, he presses the "RUN-STOP" key at the level screen. This brings the Levels Menu where he selects the firer's starting point by pressing any number key (1-10).

2) Manual Mode 2: the trainer may select one level for all firers. To choose this mode the trainer presses "L" key, hits return, and selects the same starting point and stopping point. After selecting a starting point, for example, Level 5, when prompted to choose a stopping level, the trainer again selects Level 5.

```
Start  level: 1
Final level: 10
Wind Speed: 0 MPH

  1: Introduction/Supported Position
  2: Introduction/Unsupported Position
  3: Timed Targets/Supported Position
  4: Timed Targets/Unsupported Position
  5: Practice Record Fire I
  6: Practice Record Fire II
  7: Record Fire
  8: Rapid Record Fire I
  9: Rapid Record Fire II
 10: Combat Fire

  L: Select Start/Stop Level
  N: New Firer
  W: Set Wind Speed
  G: Go To Skill Test

Press a number or letter and press
"RETURN"

?
```

Figure 3. Levels Menu

3) Manual Mode 3: the trainer selects a starting and stopping level for all firers. For this option the trainer presses the "L" key and selects a separate starting level and stopping level.

C. Wind.

1. A unique feature of the JMACS system is simulating wind speed and direction. To set wind speed, the trainer presses the "W" key followed by the "RETURN" key. The trainer's first choice is wind speed. He can select 0 MPH by pressing 1, 10 MPH by pressing 2, or 20 MPH by pressing 3 and then pressing the return key. Once the selection is made, the trainer is then requested to choose a specific wind direction. Eight effects are offered:

a. First by pressing the 1 key a "no value" wind from directly behind firer's rear is selected.

b. Pressing 2 selects a "half value" wind from the firer's left rear.

c. Choosing 3 means a "full value" wind from the firer's left directly across the range.

d. A "half value" wind from the firer's left front is the selection of number 4.

e. Pressing number 5 selects a "no value" wind coming from directly in front of the firer.

f. Number 6 chooses a right front "half value" wind.

g. Number 7 selects a "full value" wind across the firer's right.

h. Finally, by pressing 8 the trainer selects a "half value" wind coming from the firer's right rear.

2. Bullet strike will be affected by the wind speed and wind direction selected and appropriate hold-off techniques should be used. These techniques are demonstrated by the black front sight in the replay feature of levels one through four. It is important to remember that when wind speed and direction are selected, they will be included in all programs until the computer is turned off. To return to a no wind condition you must return to the levels menu, press "W", and select number 1 (0 MPH) (See paragraph D).

D. Stopping or Changing Levels of Fire

1. A built-in feature of the JMACS system is the ability to go back to the levels menu once a program has started. If a particular level of fire is not appropriate, return to the levels menu by pressing the "RUN-STOP" key when a target is shown on the monitor. If the firer shoots at a target, wait until the next target appears before pressing the "RUN-STOP" key.

2. After the "RUN-STOP" key is pressed, the computer will advance to the end of the level and display summary screens. After the summary screens are shown, the trainer presses the "2" key (or pulls the trigger) to return to the level introduction screen. Pressing the "RUN-STOP" a second time displays the Levels Menu. At this time, a new firer (press the "N" key) may begin or the trainer may select a new level (press the "L" key) for the previous firer. Each new firer must perform the skill test.

E. Explanation of Feedback

1. Diagnostic feedback may be provided after each shot, after each three round shot group, after each firing position, and/or only at the end of a completed program, depending on the level of fire being trained. The replay consists of a perfect sight picture (shown with black front sight) prior to and at the exact moment of firing. This feedback appears on the color monitor as Excellent, Good, Average, Below Average, or Poor, for the following areas:

Steady Position
Trigger Squeeze
Follow Through
Shot Location

2. After firing three rounds or a complete level of fire, the exact location of shots may be displayed on each target by range depending on the level of fire being trained.

3. During operation of the program, the trainer can monitor the progress of the firer by referring to a system status display in the top left hand corner of the screen. This display is comprised of three letters and three numbers which show the current level of fire, the target being engaged by the firer, and the number of times the firer has repeated a target exposure or firing position within a particular level. For example, a display showing the following:

L= 4/T= 2/R=1

indicates that the firer is on level 4, the second target, and has repeated this target once. When the repeat number is greater than zero, the screen border is red to indicate that the trainer should assist the firer. If the trainer selects a wind speed of 20 MPH and a full value wind from the right, this information is displayed on the upper right-hand corner of the screen as: W=20 <— .

SKILL TESTING

A. Initial Skill Test

1. This test is used to assess shooting ability and assists the trainer in identifying weak and strong shooters.

2. Each firer shoots at three simulated 250-meter E-type silhouette targets from the supported firing position and three from the unsupported firing position.

3. Diagnostic feedback is provided after each three round shot group from both the supported and unsupported positions. The feedback for each three round group is examined to determine the firer's starting level. If the diagnostic measures for the first three rounds are not satisfactory, the firer begins at level 1. If the firer passes the criteria for the first three round shot group, the second three rounds are evaluated. If the criteria for the second three round shot group are not met, the firer starts at level 2. However, all six rounds of the initial skill test must be fired before a suggested starting level is recommended. If the firer meets all the standards of the initial skill test, an extended skill test is provided to determine a higher starting level.

B. Extended Skill Test

1. The extended skill test is comprised of three target presentations at ranges of 100, 250, and 300 meters for times of 5, 8, and 9 seconds respectively, fired in a supported position. If the criteria for the diagnostic standards are not met, the extended skill test is terminated and the firer starts at level 3.

2. If the firer passes the criteria for the first three shots, then the same targets are presented and fired in an unsupported position. If the firer does not pass the diagnostic standards, the firer begins at level 4. If the standards are met, the firer begins at level 5.

TRAINING PROGRAMS

The JMACS software is organized into 10 levels of difficulty based on the marksmanship skill of the firer. This computer controlled progression/ regression through the levels of fire is based upon established standards and requires minimal trainer assistance. However, the program may be interrupted and controlled manually by the trainer to facilitate training flexibility.

A. Level of Fire I: Introduction to Supported Position

The purpose of this program is to introduce the firer to the supported position and stationary targets while applying the fundamentals of marksmanship. There is no time limit on target exposures. This allows the firer time to achieve a good supported position for each shot. Each firer receives single target presentations sequentially from 50 to 300 meters (50, 100, 150, 200, 250, and 300 meters). There are three target presentations at each range for a total of 18 targets. The firer receives a replay and diagnostic feedback after each shot. Feedback is shown on a single target after each three round group has been fired showing the exact location of each shot. A summary screen displays the average diagnostic ratings at the end of the 18 target program. Standards within this level of fire are two hits out of three targets at each range. When standards are not met at a specific range the screen border color changes to red and remains red until standards are met. The firer receives three more targets at the indicated range before advancing to the next range. When standards are met or exceeded, the border returns to black.

B. Level of Fire II: Introduction to Unsupported Position

The purpose of this program is to introduce the firer to the unsupported position and stationary targets while applying the fundamentals of marksmanship. The target scenario, replay, and diagnostic features are the same as in Level of Fire I. The standards in Level of Fire II are not as rigid because the program is more difficult.

C. Level of Fire III: Timed Targets in Supported Position

The purpose of this program is to introduce the firer to timed target exposures while firing from a supported position. The time limit for each target exposure varies from 4 seconds to 11 seconds, depending on the range of the target. Each firer receives single target presentations in random sequence at various distances to 300 meters. There are four target exposures at each range for a total of 24 targets. The firer receives diagnostic feedback for bad shots only, e.g., a poor rating for any score or a poor or below average rating for shot location. Summary feedback shows shots on a single target by range. A summary screen displays the average diagnostic ratings at the end of the 24 target program. Standards within this level of fire are three hits out of four targets at each range. When standards are not met, the screen border color changes to red and remains red until standards are met. The firer receives four more targets at the indicated range before advancing. When standards are met or exceeded, the border returns to black.

D. Level of Fire IV: Timed Targets in Unsupported Position

The purpose of this program is to introduce the firer to timed target exposures while firing from an unsupported position. The target scenario, replay, and diagnostic features are the same as in Level of Fire III. The standards in Level of Fire IV are not as rigid because the program is more difficult.

E. Level of Fire V: Practice Record Fire I

The purpose of this program is to introduce the firer to a scenario similar to record fire, but with increased performance feedback provided. During this exercise the firer practices engaging single and double targets with varying exposure times. It may be used in preparation for, or reinforcement of, field fire and live fire training. Target exposure time varies from 3 seconds to 12 seconds depending on range to target and number of exposed targets. The firer is required to engage 40 target presentations in a random sequence at distances of 50 to 300 meters. The location of bullet strikes is shown by cross hairs. A summary screen displays the number of hits, misses, and no-fires at the end of each firing position and again at the end of the program. Also at the end of each firing position a summary screen displays shot locations on a single target for each range. Standards within this level of fire are 15 out of 20 hits from both the supported and unsupported positions. If standards are not met, the firer refires the position from which he or she failed to meet or exceed the standards. As in earlier levels, the screen border color changes to red until the standards are met.

F. Level of Fire VI: Practice Record Fire II

The purpose of this program is to give the firer additional practice firing at single and double timed targets. The location of bullet strike is shown by cross hairs only when the firer misses. This program can be used to reinforce field fire and practice record fire. The target scenario, replay, and diagnostic features are the same as in Level of Fire V. The standards in Level of Fire VI are not as rigid because the program is more difficult.

G. Level of Fire VII: Record Fire

The purpose of this program is to give the firer the opportunity to fire a scenario that replicates record fire. The time limit on target exposures, the firing positions, the target presentations, and the number of targets are the same as record fire. Cross hairs are not displayed after each shot. This program can be used to prepare the firer to fire the record fire course. During this exercise bullet strike is not shown, and targets disappear when hit. A summary screen displays the number of hits, misses, and no-fires at the end of each firing position and again at the end of the course of fire. Also at the end of each firing position a summary screen displays shot locations on a single target for each range. Standards within this level of fire are 15 out of 20 hits from both the supported and unsupported positions. If standards are not met, the firer refires the position from which he or she failed to meet or exceed the standards. The border color changes to red until the standards are met.

H. Level of Fire VIII: Rapid Record Fire I

The purpose of this program is to give those firers who have mastered the previous levels the opportunity to continue building their shooting proficiency in rifle marksmanship. During this exercise, the time limit for target exposure is approximately 1/3 shorter than Record Fire. Each firer fires from the supported and unsupported positions, engaging single and double targets in random sequence from 50 to 300 meters. The firer receives feedback on location of bullet strike shown by cross hairs only for misses. A summary screen displays the number of hits, misses and no-fires at the end of each firing position and again at the end of the course of fire. Also at the end of each firing position a summary screen displays shot locations on a single target for each range. Standards within this level of fire are 15 out of 20 hits from both the supported and unsupported positions. If standards are not met, the firer refires the position from which he or she failed to meet or exceed the standards. The screen border color changes to red until the standards are met.

I. Level of Fire IX: Rapid Record Fire II

The purpose of this program is to reinforce the skills acquired during Level VIII, Rapid Record Fire I. During this exercise bullet strike is not presented, and the target disappears when hit. The target scenario, replay, and diagnostic features are the same as in Level of Fire VIII. The standards in Level of Fire IX are not as rigid because the program is more difficult.

J. Level of Fire X: Combat Fire

The purpose of this program is to provide transition for the firer from basic rifle marksmanship to advanced rifle marksmanship training. This program assists in teaching the firer rapid acquisition and engagement of stationary targets, a skill necessary to engage moving targets. Combat Fire gives the firer an opportunity to engage targets (attack and retreat) in a 40 target scenario. The 40 targets (50 - 300 meters) alternate randomly between predetermined sequences and appear on the screen in rapid succession. Cross hairs are shown for hits and misses. The Combat Fire scenario is fired twice - once from the supported position and once from the unsupported position. Standards for this level are 28 target hits from the supported position and 23 target hits from the unsupported position.

JMACS STANDARDS

The following is a list of the standards for each rifle marksmanship level. The standards are a numerical value and should not be confused with a percentage.

A. Levels 1-4 Advancement:

1. Regress 1 level = 2 scores rated poor

2. Stay at same level = 1 poor score plus 1 below average score

3. Pass to next higher level = other scores

B. Levels 1-4 Standards:

Steady Position Score, supported

a. Excellent: 95-100
b. Good: 90-94
c. Average: 84-89
d. Below Average: 79-83
e. Poor: 0-78

Steady Position Score, unsupported

a. Excellent: 92-100
b. Good: 87-91
c. Average: 81-86
d. Below Average: 76-80
e. Poor: 0-75

Trigger Squeeze Score, supported

a. Excellent: 96-100
b. Good: 92-95
c. Average: 87-91
d. Below Average: 83-86
e. Poor: 0-82

Trigger Squeeze Score, unsupported

a. Excellent: 93-100
b. Good: 86-92
c. Average: 78-85
d. Below Average: 71-77
e. Poor: 0-70

Follow Through Score, supported

a. Excellent: 95-100
b. Good: 89-94
c. Average: 82-88
d. Below Average: 76-81
e. Poor: 0-75

Follow Through Score, unsupported

a. Excellent: 93-100
b. Good: 79-92
c. Average: 64-78
d. Below Average: 50-63
e. Poor: 0-49

Shot Location Score, supported

a. Excellent: 97-100
b. Good: 93-96
c. Average: 87-92
d. Below Average: 82-86
e. Poor: 0-81

Shot Location Score, unsupported

a. Excellent: 96-100
b. Good: 91-95
c. Average: 84-90
d. Below Average: 78-83
e. Poor: 0-77

C. Levels 5-9 Advancement:

1. Regress 1 level = 1 score rated poor

2. Stay at same level = 1 score rated below average

3. Pass to next higher level = other scores

D. Levels 5-9 Standards:

Hits	Accuracy Score
a. Excellent: 39-40	a. Excellent: 97-100
b. Good: 35-38	b. Good: 95-96
c. Average: 30-34	c. Average: 92-94
d. Below Average: 26-29	d. Below Average: 90-91
e. Poor: 0-25	e. Poor: 0-89

E. Level 10

1. 28 Target Hits - supported

2. 23 Target Hits - unsupported

TROUBLESHOOTING JMACS

Problem	Solution
Computer/disk drive/monitor will not come on.	Check to see that all power cords are plugged in, or try another outlet.
JMACS program will not start.	TURN COMPUTER OFF, then reinsert JMACS cartridge.
No picture.	Recheck cable connections and monitor brightness adjustment. The front/rear switch on the back of the monitor must be set on "rear". If using a television make sure all connections into and out of TV switch box are correct.
No sound.	Check volume control; recheck cable connections.
M16 does not fire.	Check to see that the M16 is plugged in Port 1.
Light pen does not read.	Check distance to screen. It should be 8 feet from the front of the light pen or 10 feet from the firer's eye. Check to make sure the light pen is plugged in. Turn the brightness up slightly. The M16 must be zeroed each time brightness is changed. Make sure the light pen is plugged into port number 1 on the side of the computer.
Shot locations not at point of aim.	Stop program and rezero M16.
Less than three shots show on zero target.	Check distance to screen.

HIDDEN JMACS OPTIONS

A. Sight Picture (press "SP" on any levels screen)

This program is used to determine if the firer understands and can duplicate a correct sight picture. A front sight post and rear peep sight are shown at different locations on the screen. Using the joy sticks, the firer maneuvers the front and rear sights to what a correct sight picture should look like. When satisfied, the firer "shoots" the weapon by pressing one of the joy stick control buttons. Feedback, consisting of a numerical score, the firer's sight picture, and the ideal sight picture, is provided (shot replay). If the front sight post is not centered within the rear peep sight and the firer "shoots", the computer informs the firer of the error and no replay will be shown.

B. Zero and Sight Change (press "ZS" on any levels screen)

This program explains the zero process step-by-step and discusses why zeroing the M16 is important in becoming an expert shot. Shot groups are explained in detail by defining and showing examples of both "tight" and large shot groups. The computer asks several questions to make sure the firer understands the instructions presented. Next, the sight adjustment portion of the program shows in detail the process of adjusting the front and rear sights of the M16 rifle. Graphics depicting the front and rear sights help the firer to understand the steps needed to bring a shot group to the center of a target. Sample shot groups are displayed and the firer is questioned by the computer about the zeroing process. The firer is given the option of being tested on shot group analysis and zero techniques before and after viewing the entire Zero and Sight Change program.

C. Easy Version of Level 1 (press "EZ" on levels menu)

This program is identical to Level 1 except that the easy version only contains 250 meter targets. Pressing "EZ" again will return the firer to the normal Level 1.

D. Rezero (press "RZ" on either skills test feedback screen)

This program gives the trainer the option of having the firer rezero the M16.

E. Print Files (press "PF" at welcome screen or levels menu)

This program allows the trainer to obtain a hard copy of the firer's results.

F. Same Zero Target Location (press "@" at the zeroing instruction screen)

This program keeps the zero targets at the same location, in the initial skills test, over the 3 supported shots and 3 unsupported shots.

G. Numbers (press "NU" at levels menu)

This program allows the initial skill test diagnostic scores to be displayed both in alpha and numeric form. For example, an Excellent score would now read: "Excellent 98". The Numbers program works only on the initial skills test.

H. Calibrating the Light Pen (press "CA" at welcome screen)

If a firer consistently misses targets by a wide margin, but is using a good sight picture the light pen may need to be calibrated. The procedures require the firer's eye to be 10 feet from a 13" screen. (It is a good idea to check the light pen calibration periodically, especially during daily periods of heavy use.)

1. The calibration screen consists of a cross running the length of the screen from left to right and from the top of the screen to the bottom. Above the point at which the lines intersect lies a blue cross; below this point is a rectangular box.

2. Secure the M16 in a stationary position, using a chair or other fixed support. Aim at the blue cross using its midpoint as center of target mass. Pull trigger.

3. A black dot appearing within the boundary of the rectangle indicates that the light pen is calibrated.

4. If the black dot is outside the rectangle, the light pen must be adjusted to bring the dot within the area of the rectangle. The program indicates which way to move the light pen: up, down, left, or right. To move the light pen using a screwdriver, loosen the light pen mount slightly, and carefully move the light pen as required until the black dot falls within the rectangle. Tighten mount after this step is complete.

5. Next, check the sensitivity of the light pen readings by looking at the "X" and "Y" coordinates displayed in numerical form in the upper left area of the screen. These coordinates correspond to the amount of movement the black dot makes on the screen. It is very important that no outside interference affects the stationary position of the M16 while the readings are being taken. Do not lean on the table or touch or hold the M16. If the total of the X and Y readings varies by more than 4, it may be necessary to adjust the sensitivity of the light pen readings.

6. If the readings are acceptable, move the M16 slowly to the left and right. Watch the dot to insure it is following the movement of the M16. If the dot "sticks" on lines, characters, or 1 inch from the border of the screen, light pen sensitivity adjustments are required.

7. To adjust the light pen sensitivity, using a small flathead screwdriver, very slowly turn the trim pot screw located on the rear of the light pen until the black dot has stopped moving or its movement is very small. Turn the trim pot screw counter-clockwise if the black dot is stuck. Turn the

trim pot screw clockwise if the black dot is dancing more than 4 points on the screen.

8. Once light pen adjustments are made, recheck the readings by repeating Steps 4, 5, and 6. Do not, however, pull the trigger again.

SETTING UP THE JMACS PRINTER

A. Attaching the Grappler CD

1. Before attempting to use the Star Micronics NX-10 printer, attach the Grappler CD printer interface unit to the rear of the Commodore 64 computer.

2. The switches located inside the Grappler CD must be set. These switches are located on the upper right side of the Grappler CD with plug-in portion facing the rear of the computer. The switches are red or blue depending on when your Grappler was manufactured.

3. Starting from switch number 1 on the extreme right, set switches 3, 6, and 7 to the "on" or "closed" position. Set switches 1, 2, 4, and 8 to the "open" or "off" position.

4. Making sure the computer is off, plug the Grappler CD into the cartridge port (right rear) on the back of the Commodore 64 computer. (See Figure 1.)

5. Next, plug the cable from the Grappler CD into the disk drive port on the back of the Commodore 64 computer. It will not fit in the monitor port.

6. Plug the Commodore 1541 disk drive cable into the back of the Grappler CD.

7. Last, plug the Grappler CD printer ribbon cable (gray) into the back of the Star Micronics NX-10 printer (see Figure 2-10, page 17, in the NX-10 user manual).

B. For detailed instructions on loading single sheet or continuous feed papers, refer to page 10 through 15 in the Star Micronics NX-10 Printer user manual.